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TECHNIQUE OF HIGH VOLTAGE MEASUREMENTS

Before television, professional and amateur transmitter technicians were the only radio servicemen who worked with voltages higher than about 900 v. The only exception perhaps was the experimenter who built and operated special-purpose equipment. The television technician, on the other hand, encounters **high** voltages in each set he handles. The potentials he must work with range from 1,000 to 30,000 volts, as a general rule, depending upon the type of receiver, the size of the picture tube, and whether the set is of the direct-view or projection type.

High voltage measurement involves hazards and requires special techniques uncommon to the checking of low voltages. A t. v. technician-in-training must school himself thoroughly in these important matters. The experienced technician is obliged to keep constantly polished his "high voltage behavior," in order to operate with maximum efficiency and safety.

This article will describe the available instruments for high voltage measurement and will outline the procedures for making high voltage tests in television receivers.

High Voltage Instruments

Television high-voltage power supplies give low current output. In order to obtain accurate voltage readings, therefore, meters used in checking these supplies must have as high resistance as practicable. The following paragraphs describe satisfactory kilovoltmeters meeting this important requirement.

Electrostatic Voltmeter. The electrostatic voltmeter has a different operating principle than that of the dial-type instruments (d'Arsonval and movable-iron varieties) ordinarily used by the service technician. The basic operating mechanism of the electrostatic voltmeter consists of two thin, flat metallic plates or vanes separated from each other by means of a small air gap. One of these vanes is attached to the frame of the instrument in a stationary position. The other vane is mounted on pivots which turn in jewelled bearings. This second vane is free to move in the plane of its surface, so as to cover or uncover the stationary vane without touching the latter. The fixed and movable (or suspended) vanes thus constitute a variable air capacitor. Figure 1 shows this arrangement.

The position of rest of the movable vane is such as to uncover the fixed vane almost completely. When an unknown voltage is applied to the two vanes, through suitable input terminals, electrostatic attraction causes the movable vane to be drawn into a position opposite the fixed vane, the amount of movement being proportional to the strength of the voltage. A pointer attached to the movable vane moves over a calibrated scale to indicate directly the value of applied voltage. When the voltage is removed, the movable vane is returned to its position of rest by action of spiral hairsprings.

The electrostatic voltmeter may be used to check both a. c. and d. c. potentials. Its practical upper frequency limit is approximately 1 megacycle. This instrument draws practically no current from the voltage source. On

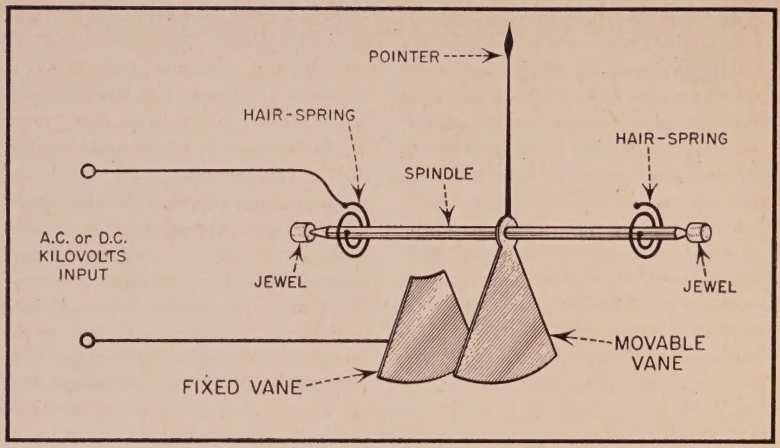


Fig. 1. Movement of the electrostatic kilovoltmeter.

d. c., there is, of course, no conductive path through the instrument and the voltmeter resistance approaches infinity. The capacitance between the fixed and movable vanes is so tiny that any displacement current resulting from a. c. applied voltages is infinitesimal.

The electrostatic instrument normally is supplied only in kilovolt ranges. It is well suited to television high voltage measurements, because of its extremely high input resistance, simplicity, and the fact that it requires no special probes. Because the electrostatic voltmeter operates on a. c. as well as d. c., it may be used to check the input to the high-voltage rectifier tube in a t. v. receiver. This is an advantage not afforded by other television kilovoltmeters which check d. c. only.

The salient advantages of the electrostatic voltmeter must be weighed against its comparatively high cost and the fact that it must always occupy the position of an "extra" meter, not being adaptable to uses other than kilovolt measurement.

Current Meter with Multiplier. A satisfactory d. c. kilovoltmeter can be made, in the conventional manner, with a d. c. current meter and appropriate high-resistance multiplier. Figure 2 shows this arrangement. To minimize circuit loading, the meter should be a microammeter, although a 0-1 d. c. milliammeter can be used in some cases. The following Table shows multiplier values required to convert various standard meters to 10,000- and 30,000-volt instruments.

Basic D. C. Meter	Multiplier Resistance (Megohms)	
	10,000 v.	30,000 v.
0-20 uA	500	1,500
0-50 uA	200	600
0-100 uA	100	300
0-200 uA	50	150
0-500 uA	20	60
0-1 ma	10	30

Special high-voltage resistors are obtainable; but since these are not ordinarily carried in store stock, the technician may prefer to construct his own multiplier using a string of series-connected 1- or 2-watt carbon resistors to total the required resistance. In constructing such multipliers, it is best practice to limit the voltage across each resistor in the series string to a maximum of 500 v., otherwise meter-damaging flashover is liable to occur. In some cases, this limitation will result in a cumbersome number of resistors.

The completed multiplier resistor must be housed carefully in an insulated case and provided with high-voltage-insulated leads, to prevent accidental contact with the operator. To minimize possibility of corona effect and attendant losses, there should be no sharp bends in any of the wiring. Also, sharp points and edges must be avoided on all terminals and soldered joints. To prevent surface leakage, the multiplier should be given a liberal coating of good wax, such as Cerese or Ceresin. Do not use paraffin.

Special d. c. kilovoltmeters comprised by a movable-coil d. c. microammeter and self-contained ultra-high-resistance multiplier also are available commercially. These instruments may be found listed in radio-electronic supply catalogues.

High-Voltage Probes. A variety of manufactured high-voltage probes is available for standard serviceman's test meters of both the electronic and non-electronic type. These probes accommodate d. c. voltages only. One set of probes has been designed especially for non-electronic d. c. voltmeters having a resistance rating of 20,000 ohms per volt. The other set is for use with d. c. vacuum tube voltmeters with basic input resistances of 10 or 16 megohms. All of these probes have special high-voltage insulation and are provided with safety flanges which increase the length of the leakage path along the outside of the probe shell, while at the same time acting as barriers to keep the operator's fingers away from the metal probe tip.

To determine the resistance value of an external multiplier to convert a

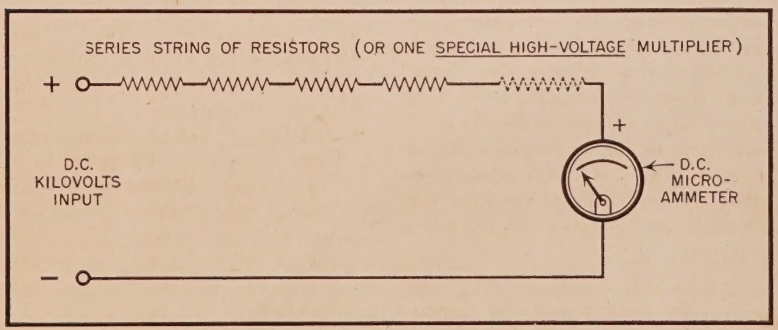


Fig. 2. D.C. kilovoltmeter made with microammeter.

high-resistance non-electronic d. c. voltmeter into a kilovoltmeter, use the equation: $R_m = FER - ER$. R_m is the required multiplier value (in ohms), F is the factor by which the original full-scale deflection of the meter is to be multiplied (thus, F is 10 when a 5,000-volt full-scale deflection is to be multiplied to 50,000 volts), E is the original full-scale deflection of the meter (in volts), and R is the ohms-per-volt rating of the meter. As an example, consider a 0-1,000 v. meter, having a rating of 20,000 ohms per volt, which is to be converted into a 0-10,000-volt meter. F in this case = 10, E = 1,000, and R = 20,000. FER — ER = 10 x 1,000 x 20,000 — 20,000,000 ohms = 180 megohms, the required value of the multiplier.

To determine the resistance value of an external multiplier to convert a d. c. vacuum tube voltmeter into a kilovoltmeter, use the equation: $R_m = (FR) - R$. Here, R_m is the required multiplier resistance value (in ohms), F the factor whereby the original full-scale deflection of the meter is to be multiplied, and R the basic input resistance of the voltmeter (in ohms). As an example, consider a v. t. voltmeter with an input resistance of 10 megohms, the 0-300-volt scale of which is to be converted to a 0-30,000-volt range. Here F= 100 (since 300 is to be multiplied to 30,000), and R = 10,000,000. $R_m = (100 \times 10{,}000{,}000) - 10{,}000{,}000 = 1{,}000{,}000{,}000 - 10{,}000{,}000 = 990{,}000{,}000$ ohms = 990 megohms, the required multiplier resistance value.

Spark Gaps. An emergency test, which incidentally we do not recommend, often is made by some television service technicians to determine quickly if the high-voltage power supply is operating. This consists of unclipping the lead from the high-voltage anode terminal of the picture tube and resting it a fraction of an inch from the chassis or B-minus terminal. When the gap is small enough for a given voltage, a continuous spark will jump between the clip terminal and chassis if the power supply unit is working.

The micrometer-adjusted spark gap is a refinement of the same sort of test. This device is connected to the two high-voltage terminals and the space between the two gap electrodes is decreased by rotating the micrometer screw. At a particular separation, a given voltage will produce a continuous spark discharge between the electrodes. The gap separation then may be read from the micrometer and referred to a calibration chart to determine the voltage.

At 25°C., 760 mm. pressure, and 80% relative humidity, the following performance is obtained with a needle gap at common t. v. anode voltages:

Volts RMS	Gap Separation (millimeters)
10,000	11.9
15,000	18.4
20,000	25.4
25,000	33.0
30,000	41.0

Recently, one manufacture has produced a miniature, adjustable ball-type spark gap, enclosed in a transparent, insulating tube for measurement of t. v. high voltages.

It is the opinion of the Editors that the spark gap type of test should be made only in an emergency when no other type of instrument is available.

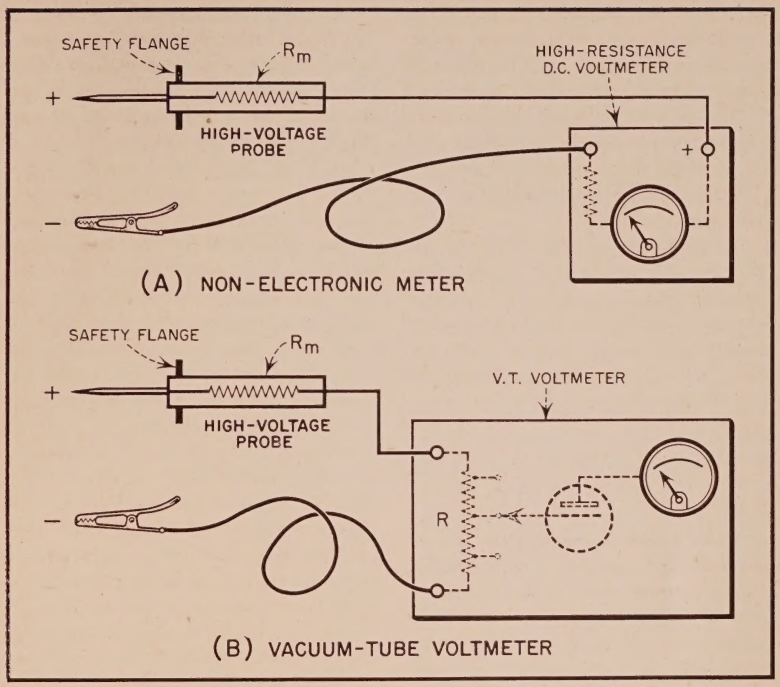


Fig. 3. External kilovolt-type meter probes.

The spark gap tends to load the power supply appreciably and accordingly can, under most practical circumstances, give rise to inaccurate voltage indications. The increased load is capable also of damaging the power supply components, especially if the spark discharge is maintained over a protracted period of time.

Test Procedure

Before making a high voltage test on a t. v. receiver, the technician must see to it that the focus, width, drive, centering, and horizontal linearity controls are set at least approximately correctly. In all receivers employing magnetic deflection, the horizontal sweep circuit must be checked for proper operation, since it is this circuit which initiates the high anode voltage for the picture tube.

A picture tube known to be in good condition must be installed in the receiver, and operating. The brightness and contrast controls must be set to their **minimum** positions. With the picture tube dark, the voltage measurement will be made under conditions which approximate those of full-load drain when the picture tube is operating, the meter circuit drawing current in place of the darkened

tube. This is important, since the t. v. high-voltage power supply has poor regulation. An accurate check will not be obtained when **both** meter and picture tube are drawing current from the supply (as would happen if the measurement were made with brightness and contrast controls at their maximum positions).

The filter components in the high-voltage power supply should be checked before attempting to measure voltage, since a defective component in this part of the circuit will give rise to an erroneous voltage indication.

Inasmuch as the high-voltage second anode lead has an insulated quick-disconnect cap, connection to the 2nd anode high-voltage terminal usually can be made only by inserting a short length of stiff wire through the rubber jacket of the connector and twisting it tightly around the grip - connector sleeve. This must be done, of course, before switching-on the set. The meter probe then subsequently may be touched to the protruding wire when taking a reading.

When using a meter of the types shown in Figures 1 and 2, with flexible leads, make all connections before switching-on the receiver. Use only high-tension insulated wire for the leads and do not, under any circumstances, handle these leads while the set is in operation. If a microammeter is used as the basis of a kilovoltmeter (See Figure 2), this must be a bakelite-cased instrument with insulated-screw zero adjuster, for maximum safety to the operator.

When using a v. t. voltmeter with high-voltage probe, be sure that the "function" switch of the instrument is in its + (positive) position. If this is not done, the meter case will be at positive d. c. potential and will become a serious electric shock hazard. Set the switches of the instrument **before** making measurements.

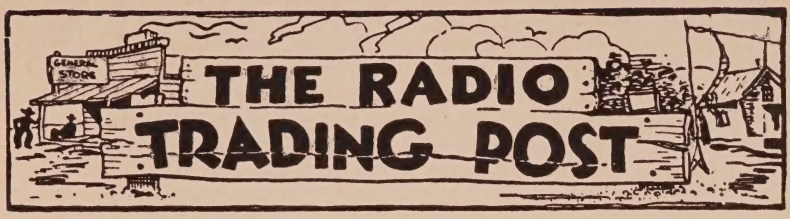
The manufactured high - voltage probes are well insulated. However, it is good practice to grasp even these probes with the fingers at the farthest possible distance back from the business end of the probe, but without allowing any portion of the hand to come into contact with the flexible leads. Neither should the leads be permitted to brush against any part of the body of the operator.

Do not toy with the high voltage measurement. First of all, connect the negative terminal of the meter to the chassis or B-minus. Then, touch the positive probe to the high-voltage point of the circuit quickly and positively and make your reading. Then, remove the probe with equal dispatch. Do not doodle or daydream. Switch-off the set as soon as a reading has been made. Then, and only then, disconnect the instrument leads.

Caution

The safe operator is the one who observes the time-honored rule of keeping his unused hand in his pocket while checking high voltages. Never, under any circumstances, make two-handed high-voltage measurements.

High voltages are not to be regarded lightly even when they are generated by low-current, poorly-regulated power supplies such as those found in t. v. receivers. If you reject the notion of being afraid of high voltage, at least respect it as a crippler and killer, and approach it accordingly.



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These advertisements are listed FREE of charge to C-D readers so if there is anything you would like to buy or sell, if you wish to obtain a position or if you have a position to offer to C-D readers, just send in your ad.

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All ads are published in the order received, but those held over two issues are discarded. Every effort will be made to include your ad either in the issue being prepared or the succeeding number, but will be automatically dropped thereafter.

SELL—Back issues Radio Craft, Radio News, Electronics, etc. Also various German tubes and equip.; one complete German command set with spare tubes, parts and diagrams. Desire experimental circuits for electronic organs. M. A. Coan, 1027 N. LaSalle St., Indianapolis, Indiana.

SWAP—CREI courses, 1 to 5, complete with examinations. Want ham gear or test equipment. A. S. Cook, 116 Ten Hills Rd., Somerville, Mass.

WANTED—All but first of 9 experimental manuals for the N.R.I. communications course, and/or all chassis for same (tester not wanted). J. St. Johns, 2858 Lake Avenue, Baltimore 13, Md.

FOR SALE—Transformers, tubes, selenium rectifiers, meters, mikes, relays, condensers, etc. Send for list then make us an offer. O'Kelly & Nelson, 3 Colbert Lane, Hilton Village, Virginia.

FOR SALE—One Model 612 Precision tube and battery tester. Counter type has built-in roll chart. Used about one hour. Price $55 postage paid. Carl J. Wilhide, 1041 Ridge Ave., Sharpsville, Pa.

FOR SALE—Riders Manuals 1 to 14 incl.; Sam's fotofacts 1 to 62 in binders; G.E. sig. gen. YGS-3 and a.c. to d.c. supply for auto radios. All in excellent condition. Very reasonable. W. J. Baker, 910 Royal Ave., Lexington, Ky.

TRADE—Will trade one Webster wire recorder for 12½" table model television receiver. D. L. Smith, c/o Smith's Radio Shop, P.O. Box 191, Leaksville, N. C.

FOR SALE—Excellent EICO millivolt meter complete. Factory tested and calibrated, $24. Stephen Plauski, 4 Irving Place, Room 1738, New York 3, N. Y.

FOR SALE—Millen 50 watt transmitter No. 90,800, $25; National 1-10 with power supply, $50. Charles Landsiedel, 192 Spring St., Red Bank, N. J.

FOR SALE OR SWAP—Edison cylinder record phonograph. Need tubes, parts, manuals, meters, etc. E. E. Youngkin, 602 E. Grant Ave., Altoona, Pa.

WANTED—Aerial coil, broadcast band, for model 37-630 Philco; dial drive (knob shafts) for model 811K RCA. Will pay cash. Dale C. Walker, Box 372, Kimball, W. Va.

FOR SALE—First $50 takes Hickok model 180X crystal controlled sig. gen. with DB meter, 100 kc to 120 mc, AM and FM, used five times. Want Revere model 90 8mm movie projector. Warren S. Gilman, Box 272, Tilton, New Hampshire.

FOR SALE—Sprague Telomike condenser tester in excellent condition, $20. James Lawless, 28 Beaufort St., Providence, R. I.

TRADE—Radio News — Oct. '48 to Oct. '50, complete. Want small audio amplifier similar to Custom Craft five watter with phono and mike inputs. W. J. Ryan, 1053 Bryant, N. Y. 59, N. Y.

FOR SALE OR TRADE—Masco MTB 13-X television booster. Nathan W. Anderson, 1114 Idaho St., Norman, Oklahoma.

FOR SALE—The famous Dumont 241, 5" oscilloscope very good inside and out, $235. Stanley Hall, 1004 No. Lincoln, Burbank, Calif.

FOR SALE—Riders Manuals No. 7 to 14, absolutely clean and immaculate. Will include Riders Record Changer Manual. First $100 takes all nine Books. Steve J. Zvara, 515 Acacia Sa., San Gabriel, Calif.

FOR SALE—Established Radio - Appliance store and service, speaker reconing service, test equipment, Rider's complete parts and stock. Good business, 25,000 population. Sell for inventory. Also sound truck. Sweeney's Radio Service, 922 W. 5th, Winona, Minnesota.

FOR SALE OR TRADE—Gates Dynamote remote amplifier with three microphones input; Collins 16F program equalizer; five complete RCA Universal transcription pickup units with equalizer for vertical and horizontal transcriptions. Want Magnacorder tape recorder. Milton Gerloff, Farmers Market, Fresno, Calif.

FOR SALE—Altec-Lansing 12" model 600 hi-fidelity speaker in perfect cond., $22; Pilotuner, $15; U.T.C. linear standard audio transformer LS-61, excellent cond., $8. T. V. DuVal, Box 93-A, Rt. 13, Richmond 26, Va.

FOR SALE—Tube and battery tester, Radiotechnic model 130 1947. Used only for hobby, perfect condition. Has carrying case, schematic, and operating instructions. Cost $56, price $29.50 f.o.b. Freeport. Paul Bolender, 407 N. Whistler, Freeport, Illinois.

FOR SALE—LM freq. meter with modulation and original 115V a.c. supply, $70; BC433-G compass rcvr. and ARB rcvr., $15 each. All items good condition. J. Girdwood, 511 Ardmore Road, Hohokus, New Jersey.

FOR SALE—LP-35 Rek-O-Kut 12" transcription turntable, $20; 110-A Scott noise suppressor, $10; LS-25 Audio transformer, $6; Garrard intermix changer with G.E. cartridge, $10. Jack Atkins, 1375 27th St., Ogden, Utah.

FOR SALE—Hallicrafters SX-71 all wave receiver (AM-NBFM) with R-42 speaker, only four months old, $175. Will pay freight to eastern U. S. L. A. Spriggs, Jr., 155 Wellington Ave., Washington, Pa.

WANTED—Hallicrafters SX-42 receiver or SX-42U and R42 speaker, both must be in A-1 condition. State price in first letter. Joseph J. Daley, Box 807, Station A, Green Bay, Wisconsin.

FOR SALE—RCA Chanalyst; 134 Polymeter; 288x Hickok sig. gen.; Precision tube tester; Heathkit scope; audio gen.; C-D condenser checker; pocket size VOM; Riders 1-14. All items in excellent shape. Make us an offer. John Gort, Worthington, Minn.

FOR SALE—Lott photo dryer, $10; N.R.I. (experiment) VTVM tester, $5; 2¼ x 3¼ Federal enlarger, f4.5 (perfect) and easel, $30; Bogen 8W amplifier, cased spkr. and mike, $25. All plus postage. Arthur Cherry, Jr., Box 65, North Branch, N. Y.

FOR SALE—Hallicrafter S40a and s-meter; BC-645, antennas, plugs, and dynamotor; 2 Lionel electric trains and all accessories; old phonograph, but in good condition. Ronald Kolstad, 4638 France Ave. S., Minneapolis 10, Minn.

FOR SALE—Excellent U. S. Television chassis. Has 2 short wave and FM and AM bands, Video front end, separate video and audio IF stages, and 1 stage of video amplification. Complete with schematics and never used 5BP4, $40. Andrew Toross, 195 Claremont Ave., N. Y. 27, N. Y.

FOR SALE—National TV-1625, $220. Bought in August, 1950. JFD double X antenna, hardware, $10. Leaving for service. W. H. Oldendorf, M.D., Dept. of Mental Hygiene, Thiells, Rockland Co., N. Y.

FOR SALE—Instruction books for: Supreme 546 and 546A and Dumont 164E scopes, 75 cents ea.; Navy LM-10 and LM-18 freq. meter, $3 ea. Also good 19 scale Post-Trig slide rule case and book, $10. James Nichols, 1907 8th, Marysville, Wash.

FOR SALE OR TRADE—Sylvania Polymeter type 134 No. 1113, complete with instruction booklet, all leads including RF probe. Want good 35mm slide projector. Walter D. Thomas, Rt. 2, Filer, Idaho.

SELL OR TRADE—Westinghouse and G.E. meters, all kinds; several U.T.C. transformers and chokes. Want Eico or other 5" scope or VOM. Victor Silvestrini, 111 Sunset Ave., Newark, New Jersey.

FOR SALE—Meissner 5 band tuning unit and multi-wave assembly No. 13-17141. 540kc to 31.6mc, band spread dial, 11" x 4", 3-gang cond., 1853 ant, 6K8 mixer, 6J7 det. tubes included, never used, communication type, instructions. M. A. Porter, 1709 N. Larrabee St., Chicago 14, Illinois.

FOR SALE OR SWAP—Weston output voltmeter model 687; Weston volt ohmeter 663; Clough Brengle signal generator OCA; Sangamo kilowatt hour meter, portable. Will sell all or trade for TV set. Carmen L. D'Amour, Fort Covington, New York.

SWAP—Resistance bridge; typewriter; absorption wavemeter BC906-D. Want condenser checker, a.c. bridge analyzer or what have you? George Wetzel, 3108 Woodland Ave., Baltimore 15, Md.

SWAP—Two Japanese combat field telephones. Complete with batteries, tools, carrying cases (all leather). Each phone is hand made and wooden case is hand finished. Want Hallicrafters model S-40A in good condition. William J. Levy, 4125 N. 8th St., Philadelphia 40, Pa.

SELL—RCA 10BP4 with mounting cradle, deflection yoke, focus coil, ion trap, flyback H. V. output transformer, complete, $25. Excess equip., 204A, 813, 242A, 2428, 837, 5BP4, 3AP1, 9JP1, class B mod. transformers, etc. Morris Levy, 1523 - 41 St., Brooklyn, N. Y.

FOR SALE—BC342 MX communications rec. with 8" speaker in good cond.; Espey model 104-TC combination tester in good condition. Set your price. J. H. Renninger, Jr., Old Phila Rd., Fullerton, Md.

FOR SALE—Clearing out forty years accumulation of antique radios, parts, early magazines, etc. Inventory would fill book, come get what you want, pay what it is worth to you. Cap's Radio Service, 55 Pepper Drive, Los Altos, Cal.

FOR SALE—9 RCA coin operated radios model MI13174. Six tube, SW and BC band, all in good working condition. Price $35 ea. f.o.b. Clayton. Sadler Radio, Clayton, New Mexico.

FOR SALE—Demonstration model G.E. tube tester, latest YTW-1 with roll chart, $35, complete with G.E. instruction manual. Bruce Radio, 1171 Union St., Manchester, N. H.

FOR SALE—Electro-Voice "Tune-O-Matic" TV booster model 3000, perfect cond., $25, complete with 4 6J6 tubes and selenium rectifier. Spoff's Radio Service, 540 E. 62nd St., Chicago 37, Ill.

FOR SALE—Shure Dynamic Mike model 55, stand and base, 25' cord, connectors, $25; set W.E. crystals, 20mc-27.9mc in 100kc steps, also several misc. crystals, $20. J. T. Winterton, 13 Grove St., Chelsea, Mass.

FOR SALE—Supreme model 574 VTVM, excellent, $50; Printomatic postcard duplicator, $5; Litewriter adv. sign, $10. M. Rafayko, 355 N. Limestone, Lexington, Ky.

FOR SALE—Radio Physics Course, Modern Radio Servicing, and Radio Trouble Shooting Handbook, by Ghirardi. Good condition, all for $8. W. J. Lazarczyk, 826 Central Ave., Dunkirk, N. Y.

WANTED—Tape or wire recorder. Will swap movie projector, photo equip., binoculars, Rider Manuals, radio text books, magazines, or ham gear. What do you need? Local swap preferred. Joseph Leeb, 1380 Merriam Ave., Bronx 52, N. Y.

FOR SALE—Hickok 610 television sweep and marker generator, condition excellent, $110. Frank Morris, 46 Main St., Danbury, Conn.

FOR SALE—Riders Manuals 2 to 10 inclusive, perfect condition, $55. Three 3' Racon trumpets, a triple connector and baby unit, $15. N. Wachal, Oconto, Wis.

FOR SALE—Used radio testing equip. and assorted parts, sacrifice, $15. George Eldelmen, 985 Simpson St., Bronx 59, N. Y.

FOR SALE—National NC-57 communications receiver in excellent condition, $55. F. S. Kuhlman, 554 Woodward, Jackson, Mich.

FOR SALE—Violin, Zither, Bud audio oscillator, shoe ice skates, BC455 recvr. Barth Radio and TV, 333 Washington, Chelsea, Michigan.

WANTED—TV chassis RCA 630TS or equivalent in working cond.; Sam's Photofacts 80 to 100; Rider's 1 to 5 abridged, and 6 and 7; battery for G.E. portable model 250. Please state price and condition. Bill Mackin, 204 - 15th St., Elyria, Ohio.

FOR SALE OR TRADE—Motors, tools, mags., intercom, lucite, mazdas, tubes, lamp fixtures. Want Micamold XTRI, or? H. Wax, 264 Division Ave., Brooklyn, N. Y.

WANTED—Glass dial scale for Goodyear Wings model 1173, W. E. Menehan, 7416 5th Ave., North Bergen, N. J.

WANTED—Radio Electronic (Radio Craft) back issue magazines. Will pay cash. Boles, 407 S. Kilbourn Ave., Chicago 24, Ill.

FOR SALE—Motorola Radio neon sign, in perfect condition, double faced, size 4' x 5', made of porcelain. $109 value for $40, shipped f.o.b. Asheville. Keemer's Radio and TV Service, 226 Merrimon Ave., Asheville, N. C.

FOR SALE—Communications rec., RAS-5 National, complete, $115; Underwood typewriter, $25; drill press, with ½" chuck and 1/3 hp. motor, $45. Also misc. meters, oil-filled condensers, amplifiers and power supplies. Paul G. Moore, Major, U.S.A.F., Ft. Walton, Fla.

FOR SALE—SX28A, $100 f.o.b.; Rider's Manuals 6 thru 13, $65. TV Service Co., 96 Egbert Rd., Bedford, Ohio.

FOR SALE OR SWAP—Philco r.f. signal generator, 120 kc. thru 35 mc., $15; Heathkit TV sweep generator, excellent, $35. Swap both toward good tape recorder. W. J. Zalner, 6 Julian St., Binghampton, N. Y.

SALE—Transvision TV set, 7" tube & magnifier. Perfect cond. New set of tubes recently installed including picture tube. No cabinet, good front panel. Make offer. Greiner Radio Service Co., 299 S. Elmwood Ave., Buffalo, N. Y.

FOR SALE—SCR522 ready to operate; BC-459A; BC224 rcvr.; 25W xmtr; Meissner EX sig. shifter, excellent; amplifier; micromatch; meters; dynamotors; small motors, other items. Send for list. Wayne Storch, Beecher, Ill.

SWAP, SELL AND BUY—Radio and TV tubes. Want portable typewriter and TV booster. Have few 3525 and 50L6 at list price. Ben's Radio, No. Tonawanda 2, N. Y.

FOR SALE—RME VHF-152A converter in excellent condition, $60; 75 watt C.W. transmitter kit TR-75, unassembled, $35. Rev. Howard E. Allen, 381 S. Howard St., Gary, Indiana.

WANTED—Used speaker K-21 for Philco model 89 radio. Also power transformer No. 8046 for above. Joseph A. Spalla, Plaza, N. Dak.

CASH OR TRADE—Speco 4T signal tracer; EBY electric eye set; phono arms L82 Astatic; Stancor tube tester transformer, output trans., A-1 cond. Send for list. John Moy, Box 169 Canal Sta., New York 13, N. Y.

SELL OR TRADE—7" Hallicrafters TV set, anchor booster, magnifier, and indoor antenna, $125; RCA Volohmyst, $65; Precision 10-12P tube tester, $80. All excellent condition. Want good sound projector. Roger Meckes, 515 South 12th Ave., Broken Bow, Nebraska.

FOR SALE—Majestic radio chassis model 90B, 130A, and 50. Also many others. Louis A. Goldstone, 1279 Sheridan Ave., Bronx 56, New York.

SELL OR TRADE—Ham gear, two 600V d.c. 250 ma. xfmrs, National PW-4 condenser less dial, 100 kc. xtal, 1 mc. xtal, two G. R. 1 amp. variac, excellent cond. Want "O" Gage railroad equip. P. E. Greenwood, 127 Dormar Dr., North Syracuse, N. Y.

FOR SALE—Hallicrafters SX-28, $80; SX-42, $125, both in good shape, no speakers; SCR-522, beautiful conversion, with power supply, 50' RG-8U cable, xtals, $40; PE-103, excellent, complete, $17. Herbert Greenberg, 775 East 52nd St., Brooklyn 3, N. Y.

TRADE—Sparx sig. tracer model 905, and R.C.P. tube tester model 316, little used. Want PA system with phone complete. Ted Bock, 144 - 18 230 Pl., Springfield Gds., L. I. 13, N. Y.

WANTED—Good 2" x 2" slide projector. Trade for new G.E. sun lamp and transformer in original cartons. George Neuschafer, P.O. Box 883, Kerrville, Texas.

WANTED—A morning job in a modern radio shop. Will complete a course in advanced television in April, 1951. Salary secondary. Staten Island area preferred, or nearby New Jersey. Frank T. Genovese, 52 Woodland Ave., Staten Island 8, N. Y.

FOR SALE—5 vols. 1 to 5 of Sam's Photofact diagrams, including TV course, $50. Alfred A. Johnson 5604 N. Western Ave., Chicago 45, Ill.

SWAP OR SELL—Sig. gen. and condenser checker combined, model SG43, audio RF o.k. from 100 kc. to 6.5 mc, first $15. Want 7" TV, typewriter, booster, Rider Manual. Brown, 525 Penna. Ave., Elmira, N. Y.

TRADE—Perfect 12" Dalmeyer, f2.9, silent shutter, focusing mount on 9" x 9" lensboard, with separate Packard shutter. Swap for 10" or 12" magnetic deflection chassis, good or fair condition. E. M. Stewart, 312 McRoberts, Boonville, Mo.

SELL OR SWAP—Complete Deforest radio-TV course with kits, approximately 2 years old. Want radio test equipment, or what have you? Bruce Psemer, 17486 St. Aubin, Detroit 12, Michigan.

FOR SALE OR SWAP—Ghirardi Radio Physics course, $5; Nelson Cooke Math., $3; Sandretto's Aeronautical Radio Engineering, $3; Weems Aircraft Plotter, $1. Want FM tuner, comm. rcvr. C. T. Fisher, 3936 Ames St., N. E. Washington 19, D. C.

WANTED—Hammarlund Comet-Pro with complete set of plug-in coils, 110V a.c. model. Sgt. Eber F. Diehl, Jr., 512th Signal Base Maint. Co., Camp Roberts, Calif.

SWAP—12 asst'd. panel meters, ten 211's, automatic 78 rpm. changer, ICA deluxe table cabinet No. 3882 with 19" x 17" panel. Want small parts, tubes, or what have you? William F. Baer, 1223 Highland Terrace, St. Louis 17, Mo.

WANTED—Precision E-200C signal gen. Also, Millen No. 90651 grid dip oscillator. Plaza Electronics, 254 Evans Ave., Elmont, L. I., N. Y.

SELL OR SWAP—TS226A/AP, Bendix 1-130A VHF sig. gen., 100-150 mc. with a.c. power supply; Jefferson neon transformer 110/12,000 volts 30 ma; two VT-127A tubes. Want LM or 221 freq. meter, VTVM, G.D. meter, photo enlarger or what am I offered? Al Waring, Box 483, Lake Ronkonkoma, L. I., N. Y.

FOR SALE—NRI magazines issues from Feb., 1946 to Sept., 1950. Also 16 special data book from NRI on PA, FM, TV, and record changers. $7.50 takes all post paid. C. B. DeMunbrun, 1504 Hayes, Muskogee, Okla.

FOR SALE—Excellent 10 watt hi. fi. audio amplifier, built-in pre-amplifier for magnetic pick-up, separate treble and bass controls, 7 tubes, push pull outputs, five output impedances, $45. Thomas Burgan, 116 - 58 130th St., S. Ozone Park, N. Y.

TRADE—Simpson model 330 dynamic mutual conductance tube tester for direct-coupled amplifier by amplifier corp. of America or Leica or Contax camera or Hickok signal generator. Marsh Radio Shop, 1448 No. 27th St., Milwaukee 5, Wis.

FOR SALE—Assembly Service. All types kits, radios, electrical and mechanical appliances. Radio Service, 1108 East 165 St., Bronx 59 N. Y.

FOR SALE OR TRADE—Two excellent model M5 Link Transceivers. Want Motorola radio-telephone, crystal controlled on 4 mc or 3500 to 4000 kc. H. H. Riley, R. 2, Aiken, S. C.

SELL OR SWAP—Instructograph, electrically operated, 10 tapes, textbooks used at RCA Institute. Any reasonable offer. John Kalewak, 169 Washington Park, Brooklyn 5, N. Y.

SELL OR TRADE—Garrard RC-50 mixer changer with G.E. variable reluctance cartridge and G. E. preamplifier, $25. Or will add cash and swap for Hallicrafters S-38 or similar receiver. Dr. Alan York, 1342 40th St., Brooklyn 18, N. Y.

FOR SALE—Heathkit VTVM model V2, very good, may need adjustment, $20; Vulcan soldering iron, a-1 cond., $2; Knight "10-in-1" radio lab. kit, $10. W. Huhn, Jr., Shelly, Pa.

WANTED—B.C.I. 222 Heterodyne freq. meter in perfect condition, with calibration book. Must be reasonably priced. W. H. Smith, 115 Eastern Ave., Bellmore, L. I., New York.

WANTED—National NPW-O or PW-O dial and gear drive unit. Advise condition, and your price. Have tubes if swap desired. Leo W. Brandt, The Heights, Michigan.

FOR SALE—50' hanks of genuine nylon standard .032 dial cable, postpaid 50 cents each. Vincent Iavarone, 1218 Leland Ave., Bronx 60, N. Y.

FOR SALE—Heathkit VTVM, complete with test leads and schematic, perfect condition. A. H. Steinberg, 14-27 Chandler Dr., Fair Lawn, N. J.

SELL OR TRADE—Excellent magnetron tube, JAN 725A, $18. Or what have you? John Sakona, 976 Gates Ave., Brooklyn 21, N. Y.

FOR SALE—NRI Service Manual vol. 1, 1598 pages — AM-FM, TV, audio amplifiers, record changers, schematic diagrams and alignment procedures from 1931 to 1946, $10 postpaid. Ben Marconi, 120 Gatling Pl., Brooklyn 9, N. Y.

SELL OR SWAP—Excellent 3 h.p. gasoline engine; 1 K.V. 110V a.c. generator; excellent S.C.R. 518 altimeter with 29 tubes; also other articles. Want good communications receiver. Al Balchunas, 682 Burncoat St., Worcester 6, Mass.

WANTED—Dodge auto generator, 12 volts. C. W. Young, 2320 Coles Ave., Scotch Plains, N. J.

FOR SALE—2 complete used Raytheon radar sets, type "SO 1" with quantity of spares and magnetrons. R. H. Frey, 115 Broad St., 10th Floor, New York 4, N. Y.

TRADE—Army model Colt .45 cal. pistol, with holster, excellent condition. Want good clean communications receiver. George E. Blosus, 212 Shevlin Ave., Bemidji, Minn.

FOR SALE—RCA Service Notes 23-28, 31-32, 33, 34, and 35, $1.50 ea., postpaid. M. Herman, 417 Raritan St., Camden 5, N. J.

TRADE—Webster-Chicago wire recorder model 80 slightly used but in excellent operating condition. Want disc recorder, or what have you? S. T. Jazowski, 335 17th Ave., Irvington 11, N. J.

FOR SALE—General Industries disc recorder-playback with 12 watt amplifier in carrying case, good condition, $25, express collect. R. G. Tuck, Point of Rocks, Md.

FOR SALE—RCA 155-C oscilloscope; Triplett 169A modulation monitor. George Kravitz, 7919 20th Ave., Brooklyn 14, New York.

WILL BUY, SELL OR TRADE—Radio and TV tubes. Send your lists for trade and those wanted. Andrew's, 740 Maple St., Bethlehem, Pa.

FOR SALE—Pentron wire recorder, model W-449, two months old, with one hour spool of Pentron wire, A-1 condition, $90 cash. J. E. Lachette, 309 Hillside Ave., Brookhaven, Pa.

FOR SALE—R-9A-APN-4 Loran receiver, 16 tubes, excellent, $20; BC-430 transmitter 3200-4000 kc., less power supply, $5, or best offer. K. Q. Miller, 1225 "L" St., Lincoln, Nebr.

WANTED—Solar condenser test regardless of condition. State defects and condition and also lowest price. W. Lofstrom, 1302 West Hill Ave., Valdesta, Georgia.

FOR SALE—Heathkit sig. gen., assembled model G-1, $11; Feiler sig. tracing analyzer model TS-2, $18. Both include instruction booklets. Shipping charges I pay. W. Gretes, 103 East 28 St., Norfolk, Virginia.

FOR SALE—5" Heathkit oscilloscope, perfect condition, $30. Sidney Winters, 143 Heyward St., Brooklyn 6, N. Y.

FOR SALE—Garod model 5D4 3-way portable radio, good condition, with batts., $19.50; Corona portable typewriter, good condition, $15; VOM tester, leather case, $10. Dick Bruce, 1171 Union St., Manchester, N. H.

FOR SALE—RCA power amp. MI-4288-JY; RCA vol. amp. MI-4297-AY; Rcvr. BC-1004-C (Super Pro. with pwr. pack; RCA 25 watt P.A. amp. MI-12225; Mic Astatic "DN-HZ"; Mic Shure 707A. All used good cond., best offer. Claude L. Stuart, Quarters T-206, Aberdeen Proving Ground, Maryland.

FOR SALE—Black Flyer 2-speed motor, $8; VM-2 UTC 60 watt modulation transformer, $7.50; 3 each GE-0-50 MA 3" sq. meters, $3.25 ea. All excellent cond. Want BC-454, 455, 696, BC-1068 or BC-1267 front end 522 xmtr., all in original condition. I Seidman, 1535 Longfellow Ave., New York 60, N. Y.

TRADE OR SELL—Tubes 77, 75, 39/44, 36, 5Y3G, 3S4, 1T4, and 1R5, all tested good. If traded I would like tubes No. 80, 6SG7, and 1G4G. Also want used Stancor trans. No. P-4078. Richard Turner, 119 Third St., Lakeview, Michigan.

SELL OR TRADE—Sprayberry Radio-TV course, including all experiments; Heath vacuum tube voltmeter, and sig. gen.; Meck tube tester. Want 7" TV set in good working condition. R. P. Bosom, 2048 Thorburn St., Holt, Mich.

FOR SALE—2 band Meissner radio rec.; RCA sound amplifier; 7" Transmission TV rec.; BC-654-A Supreme tube and set tester; model 592 Supreme VOM; assorted tubes, transformers, etc. Carl M. Stutsman, 119 North Ashland Ave., Lexington 37, Kentucky.

WILL TRADE—Craftsman 6" swing metal lathe, 18" between centers, complete with gears and 4 jaw chuck, for Multitester. Jos. F. Bauer, Carrington, Dr., Fullerton, Md.

WANTED—Riders 3, 4, and 5; 7A8 tubes; "Game Getter" gun. Sell BC-222 Walky Talky; small air compressor; Weston low range ohmeter, 0-10 and 0-1000 ohm, A-1 shape. Saxton's Radio and Electric Service, R 1, Pontiac, Illinois.

TRADE—Zenith auto radio (Nash deluxe). Want Riders TV Manuals 2 or 3, or a 5" scope. Edward Krupa, 2500 E. Indiana Ave., Philadelphia 34, Pa.

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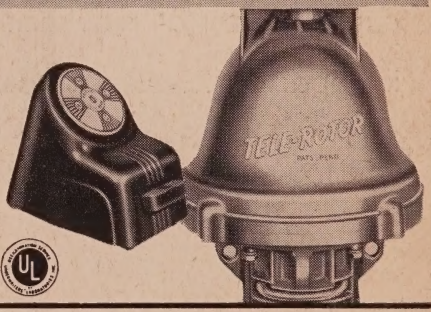

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